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AUTHOR DiNucci, James M.
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ABSTRACT

The ability to attain and maintain a body position or balance is considered important in learning and performing motor skills. Static balance is defined as balance in which the body maintains equilibrium for one position; dynamic balance is described as maintaining equilibrium while the body is in motion or changing from one balanced position to another. A sample of 379 boys and 329 girls enrolled in the public schools of Nacogdoches, Texas, were selected as subjects for an investigation of static balance relative to sex and grade differences for primary grade children and the possible relationship of selected anthropometric measures to static balance performance. The assumption was made that students tested were representative of the various social, economic, and ethnic groups of children within the community since the entire population of the first three grades was tested. The measure of static balance used in this investigation was the Bass lengthwise stick test, which was constructed by means of factor analysis as a measure of static balance. The testing apparatus was a 12-inch by 12-inch board with a stick 1 inch wide and 12 inches long positioned in the center. After an extensive practice session, each subject was allowed three trials to attempt to remain balanced for one minute on the 1-inch rail with the preferred foot. The test was taken in tennis shoes and with the eyes open. In addition, the standing height, body weight, sitting height, and leg length of the subjects were recorded. The data were statistically analyzed by application of a 2 X 3 factorial design. It was concluded that static balance performance is relatively independent of body weight and height measurements. (MM)

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STATIC BALANCE: A COMPARATIVE STUDY OF PRIMARY AGE BOYS AND GIRLS

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by

James M. DiNucci, Ph.D.

Introduction

The ability to attain and maintain a body position or balance, has been considered to be an important factor in learning and performaing motor skills and the current emphasis on perceptual motor activities has renewed the research emphasis in this area of motor performance. Bass (1) conducted an extensive study of balance and identified two types of balance, labeled static and dynamic, which are exhibited in the performance of motor activities. Static balance is defined as balance in which the body maintains equilibrium for one position. Dynamic balance is described as maintaining equilibrium while the body is in motion or in changing from one balanced position to another.

While considerable research has been conducted investigating various aspects of balance little information is available relative to the differences between the balance performance of boys and girls in the elementary grades or the relationship of various anthropometric measures to balance performance. The purpose then of this investigation was to examine static balance relative to sex and grade differences

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for lower elementary children and the possible relationship of selected anthropometric measures to static balance performance.

Literature Review

The topic of balance has been investigated extensively over the years by numerous researchers. Various sources have identified the factor of balance as one of the important elements of total physical fitness. Balance ability has also been considered an essential element for the successful movement patterns which maintain the body's positions in space in relation to gravity. Balance ability is necessary in movements ranging from simple postural maintenance to complex sports skills. Investigators seem to agree that individuals do not possess a general balancing ability applicable to all movement situations. Instead, each task demands a different and specific balance ability.

Relatively speaking, balance has been extensively studied from the standpoint of age, height, and weight. Seashore (9) attempted to develop a test for measuring the development of the present status of motor abilities in children to adults. The subjects selected for inclusion in this study were 30 males of varying ages. After determining reliabilities, Seashore calculated the relationship of age to balance and concluded that balance as a function reached relative maturity rather early in adolescence. For younger groups, height and weight were significantly related to balance scores; however, height and weight were not related to balance in the adolescent years. A wide range of performance was noted within each age group.

Espenschade (3) investigated the development of motor coordination in boys and girls. Subjects included in the study were 325 girls and 285 boys ranging in age from 10.5 years to 16 years. The Brace test was selected as a measure of motor coordination because many of the stunts in the Brace battery required a high degree of balance. Results were interpreted by analyzing trends in the development of the various classes of coordination. Test items which required control (with balance being common to all) showed a decline or "lag" during the adolescent stages for the boys. Girls' scores did not display a similar trend, with little change in balance being in evidence over the selected age range for girls. Espenschade concluded that as a result of rapid changes in physique and body proportions, a boy is possibly less able to adjust to unfamiliar balance situations than a girl of corresponding age. After the age of 15, the rate of gain in control for boys was slower than the rate of gain in agility.

In a follow-up study, Espenschade, Dable, and Schoendibe (4) investigated balance in adolescent boys. The Seashore beam-walking test was selected to measure dynamic balance. Two hundred eighty-seven boys were selected as subjects and assigned to five groups, according to level of maturity. Scores on the balance test revealed a consistent gain in performance with age; however, the rate of change from 13 to 15 years was less than the age levels prior to or succeeding that age range. The pre and postadolescent curve rose sharply, but little gain was evidenced in the performance of the three intermediate levels.

Seils (10) observed greater performances from age to age for primary age children relative to balance, agility, jumping, throwing and other motor skills. This same conclusion has been drawn by other investigators (5, 6) thereby establishing that motor abilities generally improve with age through childhood.

Relative to sex differences, it has been assumed and generally documented that boys have a slight advantage over girls in perfroming motor skills during the early elementary grades although the extent of this advantage has not been investigated.

Research Procedures

To achieve the objectives of this investigation a sample of 379 boys and 329 girls enrolled in the public schools of Nacogdoches, Texas were selected as subjects. This sample represented the entire population of boys and girls in grades one, two, and three who were available for testing during the spring semester of 1974. The exact size of the sample for each grade is presented in table 1.

Table 1

Sample Size by Grade Level

	GRADE 1	GRADE 2	GRADE 3
BOYS	104	136	139
GIRLS	124	99	106

Students having any known physical disability, as noted in school health records or in a conference with the classroom teachers, were not included as subjects. The assumption was made that students tested were representative of the various

social, economic, and ethnic groups of boys and girls within the community as every effort was made to test the total available population in these grades.

The measure of static balance utilized in this investigation was the Bass lengthwise stick test. The Bass stick tests were constructed by means of factor analysis as measures of static balance (1). These test items have been utilized in numerous research efforts (2, 8) and have reported reliability coefficients of .900 and higher (7). The testing apparatus was a 12 inch by 12 inch board with a stick 1 inch wide and 12 inches long positioned in the center.

Each subject was allowed three trials after an extensive orientation and practice session. Each trial consisted of an attempt to remain balanced on the 1 inch rail with the preferred foot for 1 minute and the subject's final score was the average of the three trials recorded in seconds. The test was taken with tennis shoes on and the eyes open.

In addition to the Bass lengthwise stick test, the standing height, body weight, sitting height and leg length of the subjects was assessed and recorded.

Following the administration of the test items to the sample population, the data were statistically analyzed by application of a 2 X 3 factorial design to determine the grade and sex differences and multiple correlation and regression to determine if static balance ability can be predicted from various anthropometric measures.

Results

Computation of the double classification ANOVA to determine grade and sex differences yielded the statistical data presented in Table 2.

Table 2

Two-Way ANOVA Data

Source	M.S.	DF	F-Ratio	P
Total	88.09	707		
Between	1108.31	5		
Sex	141.50	1	1.79	.180
Grade	2539.42	2	31.42	.001
Sex by Grade	159.10	2	1.97	.140
Within	80.83	702		

As observed in Table 2, the only significant difference found was for the comparison of the grade levels with the probability reaching .001. Comparison of the boys and girls and the interaction effect were not significant. To determine the location of the significant differences, the grade level means were compared by the Scheffe method of multiple comparisons. Table 3 presents the differences between the grade level means.

Table 3

Grade Level Mean Differences (seconds)

Comparison Means	Comparison Mean _ Smallest Mean	Comparison Mean _ Second Smallest Mean
12.65 (Grade 3)	12.65 - 6.25 = 6.40	12.65 - 7.98 = 4.67
7.98 (Grade 2)	7.98 - 6.25 = 1.73	- - - - - - - - - -
6.25 (Grade 1)	- - - - - - - - - -	

Comparison of each pair of means was accomplished in decending order of difference with the largest difference between means compared first. A comparison of the means of the first and third grades yielded a difference of 6.40 seconds. The computed Scheffe value was 2.51 which and, since the difference between means exceeded this value, the difference was significant at the .01 level. The mean difference between the third grade performance and the second grade performance was 4.67 seconds which was also significant at the .01 level. The smallest difference between means was 1.73 seconds observed as the difference between the performances of children in grade one and those in grade two. Computation of the Scheffe test found this value to be not significant at either the .01 or .05 level of significance.

Following completion of the ANOVA procedures and comparison of sample means, correlation and regression procedures were utilized to determine the possibility of predicting static balance performance from anthropometric data. The first step in this analysis was the computation of Pearson product-moment correlation coefficients between each anthropometric variable and the criterion of the Bass average. These coefficients are presented in Table 4.

Table 4

Pearson Product-Moment Correlation Coefficients

	Height	Weight	Sit Height	Leg Length	Bass
Height	1.000	0.775	0.855	0.915	0.190
Weight	0.775	1.000	0.752	0.645	0.077
Sit Height	0.855	0.752	1.000	0.567	0.187
Leg Length	0.915	0.645	0.567	1.000	0.152
Bass	0.190	0.077	0.187	0.152	1.000

Utilization of standing height, weight, sitting height, and leg length to predict performance on the Bass lengthwise stick test resulted in a multiple correlation coefficient of R = 0.235. To be significant at the .01 level a multiple correlation of .115 was required and, therefore, the calculated multiple correlation of 0.235 was statistically significant at that level. Although this value was statistically significant, it was not sufficiently high enough to warrant prediction of the criterion and, therefore, a regression equation was not developed.

Discussion

The purpose of this investigation was to examine the possible sex and grade level differences for children in the lower elementary grades in terms of static balance performance and to determine if it is possible to predict static balance performance from a combination of selected anthropometric measurements.

Application of ANOVA procedures to examine possible sex differences resulted in an F-ratio not significant at the .05 level which indicates that boys and girls in the lower elementary grades have approximately the same static balance performance abilities. This conclusion is in general agreement with results of most previous research reporting similar performance abilities for boys and girls of this age level.

Observation of the grade level differences resulted in an F-ratio significant at the .001 level. Application of the Scheffe method of multiple comparison brought forth the conclusion that, while children in grades one and two have similar static balance performance abilities, children in grade three score 2.2 times better than those in grade one and 1.5 times better than children

in grade two. The magnitude of difference between grades would indicate that a motor maturational growth spurt in terms of static balance occurs just prior to or during the third grade. This conclusion is speculatory in nature and bears further investigation.

The possibility of utilizing selected anthropometric measures to predict static balance performance was investigated and resulted in the conclusion that only a very minimal relationship exists between standing height, body weight, leg length, sitting height, and static balance performance. This portion of this study was undertaken as a result of empirical observation from a previous research project where it appeared that children with long limbs or great gross bulk had a more difficult time performing static balance activities. In light of the findings of this present investigation, it would appear that static balance performance is relatively independent of body weight and length measurements.

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